The social fabric of Jeans': Assessing the social: Coupling social simulation and assessment methods

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Assessing the Social: Coupling social simulation and assessment methods[1]

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The culture and manufacturing of the cotton fabric used to make your Jeans' may have implied the use of fertilizers or pesticides polluting a water basin, have led to relocating people and even of children labour at different stages of its fabrication. As a consumer you probably didn't take all these consequences into account (for your sake most of the information is not available, or value-wise you feel unconcerned) and you surely preferred to buy the cheapest one or to follow the fashion trend. Basically, every economic or public activity has repercussions directly, or through a chain of consequences on the environment and the society. In order to try and measure those impacts, or to valuate one choice (Jeans' L) compared to another (Jeans' P&J), several assessment methods have been developed and are frequently used. As a self-evident truth, assessment methods are instruments used to evaluate something. These could include measuring a performance on a specific case. In terms of evaluating policies and strategies, their possible outcomes are intended to evaluate their potential impacts. This refers to impact assessment in which past (already implemented actions) or future (ex-ante analysis) performances are studied.

Such assessment methods have proliferated in the last decade. Via an Internet search, Vanclay (2004) identified over 100 types of impact assessment, although many are not intended as major forms of assessment. Physical assessment (e.g. Life Cycle Assessment (LCA)), monetary assessment (e.g. Cost Benefit Analysis (CBA)), scenario analysis (tools with prospective character), multi-criteria analysis, Integrated Assessment, Triple Bottom-Line Assessment, Sustainability Assessment, Extended Impact Assessment, Multi-Criteria Analysis, Risk Assessment tools, are used in the literature to promote the use of impact assessment as a means of directing planning and decision-making towards sustainable development. Facing this huge literature, Dalal-Clayton and Sadler (2004) judiciously observe that *"the alphabet soup of acronyms and terms currently makes for a confusing picture"*. There have been also a considerable number of comparisons of these assessment methods (Lee et al., 2003; Eales and Twigger-Ross, 2003; Rorarius, 2007; Hacking and Guthrie, 2008). This is also one of the aims of the MATISSE (Methods and Tools for Integrated Sustainability Assessment (ISA)) project, funded by the European Commission, which seeks to examine ISA's possibilities for the process of developing and implementing policies for a more sustainable Europe. In this project the main task is to develop, test and demonstrate new and improved methods and tools for conducting ISA.[2]

The main problem when you have to choose one method among the others is that each rests upon several assumptions (time horizon considered, which externalities are the most important, operationalization…) and is limited to a particular aspect and, either concerning

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[2] For more information on MATISSE, see http://www.matisse-project.net/projectcomm/

the impacts you are focusing on or on the aim of your assessment. For instance, Life Cycle Assessment (LCA) (Guinée, 2002) focuses more on the embedded resources consumption "from cradle to grave" of a given product while Cost-Benefit Analyses (CBA) (Nas, 1996) is more often used when facing a choice, trying to gather in a single dimension (i.e. money) the different impacts, whether social, economic or environmental, of each option.

The choice of method will also influence the specification of the problem in the sense that the problem definition partly must be fitted to the method. But what if studies with different analytic paradigms result in different conclusions? Examples of controversies are numerous: in waste management, CBA concludes waste incineration of paper and plastics should be preferred to recycling options and LCA practitioners argue the opposite. Current Norwegian policy on fish resources, based on theory of optimal resource utilization, suggests larger units, less coastal boats while other methodological approaches such as system dynamics suggest larger coastal fleet to be the better option (Vogstad, 2002).

In addition to these two latter methods, LCA and CBA, we drew two other methods from the literature: on the one hand Corporate Social Responsibility (CSR) (Freeman, 1984) that includes a set of ethical requirements concerning the activity of firms (e.g. no child labour, reasonable remuneration of workers, equal opportunities, etc.) and on the other hand Integrated Assessment as such (IA)[3] which is an iterative participatory process to evaluate the whole cause-effect chain of a problem involving scientists from different disciplines as well as stakeholders.

One serious challenge for all these methods is their adequacy to actually account for the social dimension in the main or secondary impact levels. Environmental and economic dimensions are most of the time accounted for and even combined but social dimensions are left out or play a smaller role. In order to evaluate policies in relations to wider sustainability impacts, in principle, the three dimensions should be addressed and considered together.

We then present these methods into further details. Integrated Assessment (IA) can be described as *"a structured process of dealing with complex issues, using knowledge from various scientific disciplines and/or stakeholders, such that integrated insights are made available to decision makers"* (Rotmans, 1998). In general, there are two separate methods for integrated assessment: analytical methods and participatory methods. The first is usually based on natural sciences whereas the latter stems from social sciences. Analytical methods toolkit, in principle, consists of model, scenario, and risk analysis. Participatory methods are made of dialogue and mutual learning methods as well as policy exercises. Both of them involve non-scientists as stakeholders in the process.

The Life Cycle Assessment (LCA) is a tool for the systematic evaluation of the environmental aspects of a product or service system through all stages of its life cycle. It provides a sufficient instrument for environmental decision support. Moreover, LCA identifies and quantifies the environmental loads involved such as the energy and raw materials consumed and, the emissions and wastes generated. It evaluates the potential environmental impacts of these loads and assesses the options available for reducing these environmental impacts. LCA has proven to be a valuable tool to document the environmental considerations that need to be part of decision-making towards sustainability (UNEP, 2003).

The Cost-Benefit Analysis (CBA) is an economic tool, which can be used to help decision-making in evaluating public or private investment proposals. In principle investment proposals are evaluated based on willingness to pay in order to avoid certain cost (e.g. environmental, social) or willingness to pay in order to gain benefits. The main problem with CBA is its simplistic way of putting a monetary value for everything. In the realm, one cannot always rate certain values (e.g. freedom, ecosystems) in monetary terms. Moreover, it is

[3] The Integrated Assessment Society http://www.tias.uni-osnabrueck.de/

typical that CBA only concentrates on two dimensions (e.g. environmental-economic) at a time.

Social Impact Assessment (SIA) can be defined as "the process of assessing or estimating, in advance, the social consequences that are likely to follow from specific policy actions or project development, particularly in the context of appropriate national, state, or provincial environmental policy legislation" (Becker, 2001). One of the problems, especially in the macro-level (e.g. national political and legal systems), is the complexity of consultation.

In order to assess these four methods, to confront the different assumptions they are based on and to identify their strengths and weaknesses, we propose to use social simulation in order to build an artificial society that would be simplistic enough to enable a clear understanding of the pitfalls in applying each method and detailed enough to take into account explicitly the most important aspects, i.e. have an explicit description of the social and environmental externalities of the whole cause-effect chain concerning the production of a good or a service.

Coupling of some assessment method with social simulation has been already proposed by (Moss, Pahl-Wostl, 2001; Tucker, Smith, 1999 ; Pahl-Wostl, 2002; Krywkow et al., 2002). In our contribution, the artificial society would then enable us to plug the four assessment methods identified and then to compare their results on specific case studies.

In a first step, we have systematically compared the features of the 4 methods. Main results are summarized in the following table.

	CSR	**CBA**	**LCA**	**(S)IA**[4]
What? How?	Evaluation of the voluntary social and environmental actions taken by firms beyond compliance with legal requirements	Evaluation of options based on their impacts (costs / benefits) accounted in monetary value	Systemic modelling of product or process to assess all consumed and produced elements and measure their impact	Multi-disciplinary evaluation of the whole cause-effect chain of a problem, when used for decision
What is assessed	Firm, corporate management, products, projects	Projects, options, actions	Products, processes, chains	Situations (*-scales), projects
Who uses the assessment?	Managers, investors, customers, NGOs, rating agencies	Project leaders, funders, decision or policy makers	Producers, consumers	Public managers, policy makers, public funders
Why?	- gain competitive advantage, reputation - improve business model - cope with uncertainty - mitigate negative impacts - ethical reasons	- compare and choose among a set of options, based on monetary arguments	- qualify and improve products and processes - quality labels & certification → market	- qualify situations for multiple dimensions - compare and choose among a set of options, for multiple dimensions
Descriptive / normative	D & N	D & N	D (N if aggregation weights)	D

[4] Including multi-criteria assessment methods as a sub-tool

Formalism, form	- description - indicators - labels	Monetary value	- mid-terms : causal model - end-terms : indicators (- mark for label)	- dimensions - causal model - integration model - documented options
Manipulations / perversions	- green / social washing	- hidden values - monodimensional - discount rate - linear projection	- aggregation (if any)	- relativism - complexity

A critical issue is our ability to accommodate the diversity of the application domains and levels: public and private actions and policies, types of entities or processes assessed, and the formalisms used.

Based on this analysis, we then started to build a framework, identifying the main generic concepts necessary to build an artificial society[5] that aims at modelling a cause-effect chain for the production of a good or a public policy implementation. This framework is mainly based on three concepts - Resources, Actors and Transformers -:

- ***Resources*** are the elementary entities involved in the process to be studied. They will be provided as input by the transformers and can be produced as an output of a transformer. Resources can be primary resources (not produced by a transformer but available in the environment (i.e. soil, water…) or more elaborated resources (Jeans' for instance). They can be either tangible (a car) or intangible (knowledge). Resources can also represent other factors, such as energy, or human labour (workload) needed. In order to cope and integrate the whole history of a product (a resource) we keep track of all the resources and processes used to produce it.
- A ***Transformer*** is a generic entity encapsulating the process of transformation of resources towards a given aim. It uses resources as input and most of the time produces (other) resources as an output. It can be also tangible (a factory transforming cotton threads into fabric) or intangible (in the final paper we will describe in detail an innovation transformer, a transportation transformer, a learning transformer and an economic exchange transformer as convincing examples of the generality of the approach). A transformer is then used to represent not only the effective transformation of resources into a good using physical transformation but also activities that could be identified to capabilities (for instance 'recruiting work force' could be represented as a transformer between 'money', 'available time for some people' and 'workforce'). An important point is that transformers are not pro-active entities, they are controlled (generated, activated and stopped) by Actors. Some transformers are parameterized: an "information" resource is used as input and determines some features of the resource output.
- ***Actors*** represent the entities of the considered system having a decision capability that has an impact at the modelling level considered. Actors possess (control) resources and can use transformers to process resources in order to achieve some goals that are explicitly defined. Depending on the modelling grain, human resources could then be represented either as resources used by a transformer or by actors who decide to exchange their capabilities and resources to a transformer (a firm) in exchange of money (and/or social reward…). The decision process is a pretty classic goals-plans-resources model including an assessment of the needs, followed by a measure of the transformers' capacities to fulfil

[5] Such an aim is not new. From the Santa Fe Artificial Stock Market of Brian Arthur to the ACE trading world of L. Tesfatsion, several similar works exists concerning the reconstruction of artificial worlds.

them, and a last assessment of the resources available to activate these focal transformers. In a future stage we consider the possibility of using a more complex social deliberation based on the DEPNET approach (Conte and Sichman, 1995).

Formally, the resources – transformers system is a discrete-events system (with transitions also controlled by the actors when they decide to "activate" a transformer), but the interaction graph is not fixed in most of the implementations (typically some transformers can establish a new connexion between components of the system, as for a "transporter").

The last part of the infrastructure is the monitoring module, which observes the overall evolution of different variables in the system. These variables should be at least compatible with the minimum requirements of the four methods investigated, and should also include additional variables related to the global social dynamics such as the social costs and social impact of what is assessed. The basic observables planned to be used are the consumption of the different resources in a given product, tracking their history in a kind of universal labeling as for energy systems.

We then started to instantiate concretely this framework on a sample which concerns the cause-effect chain of the production of a Jeans', i.e. from the cotton field to the shopping centre. This example as been first described graphically as a network of resources, transformers and actors (cf. Fig.1) and then implemented on the platform Netlogo 4.0 (cf. Fig.2).

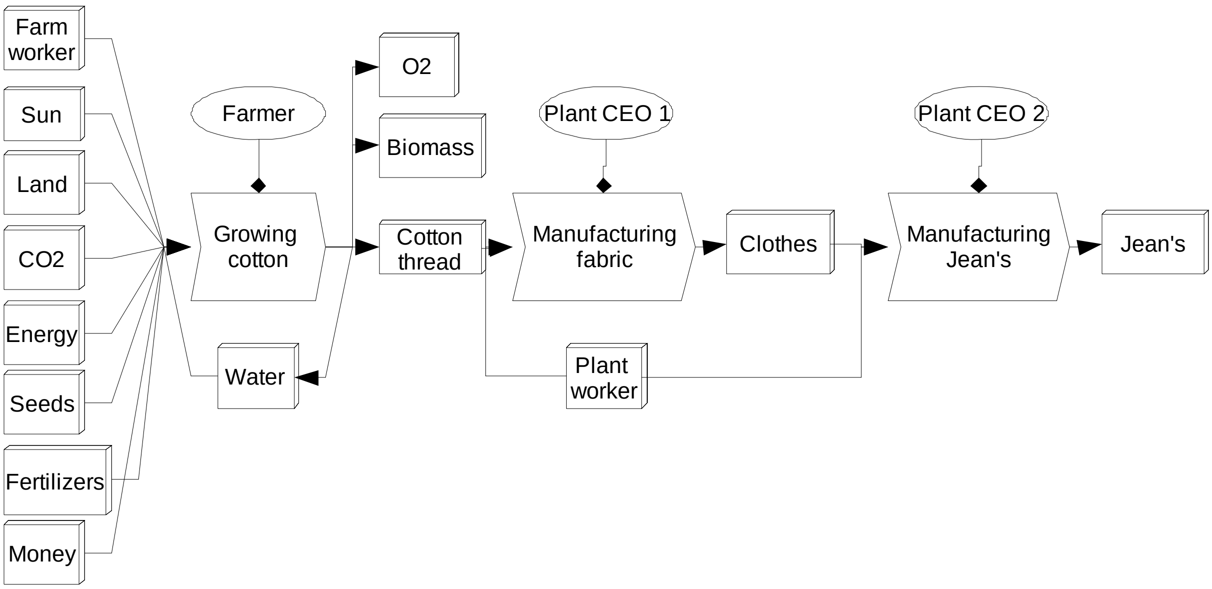

Fig. 1: Jeans' life cycle identifying resources, transformers and actors that are relevant in a first attempt. Actors are represented as ovals, resources as 3D squares and Transformers as large arrows.

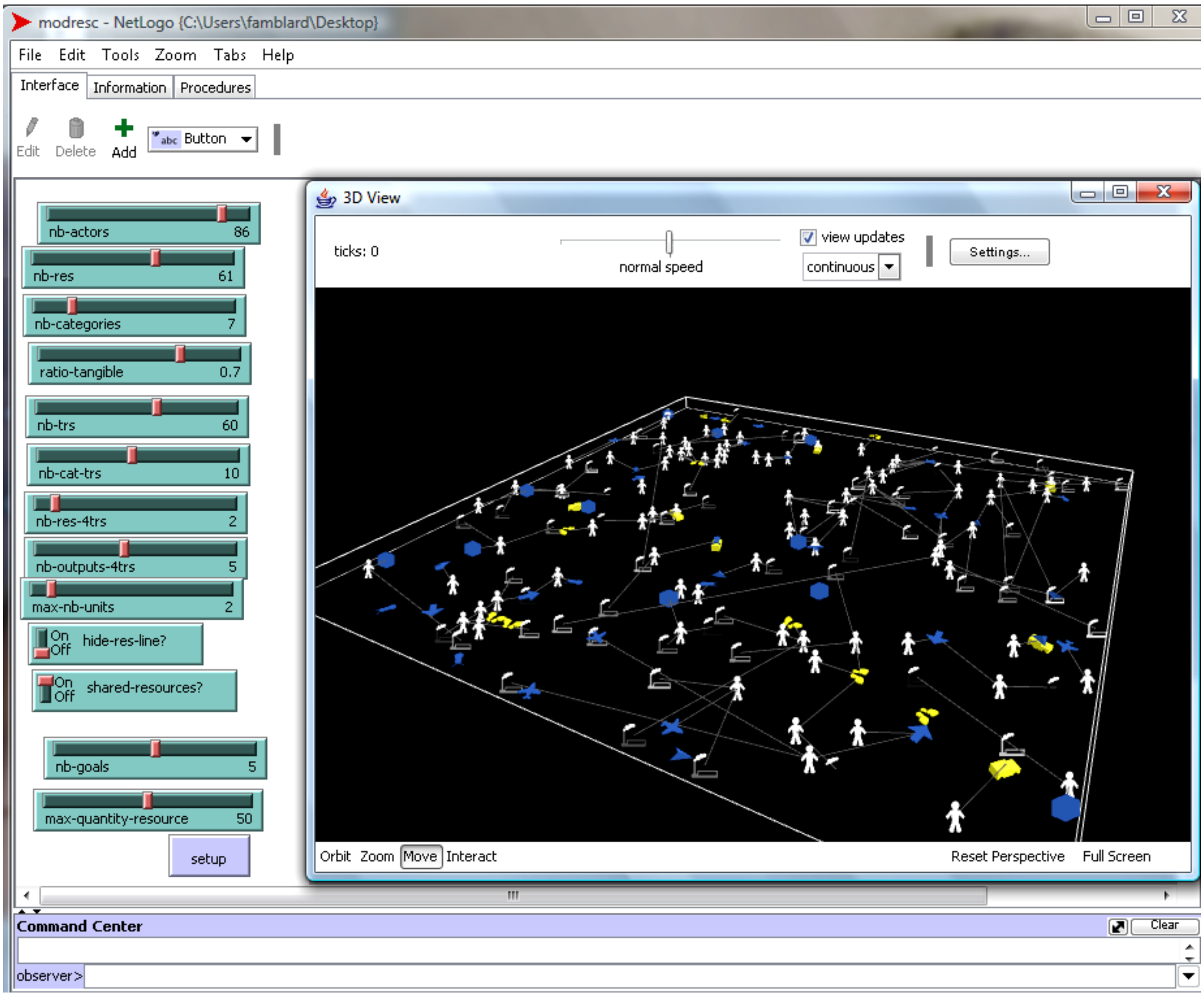

Fig.2: Netlogo model of the Jeans' chain

The Jeans' life cycle sample, from cotton field to shopping centre, enabled us to test the applicability of the proposed framework. Even if we limited the formalization of this particular example convinced us it was indeed a very fruitful way of envisaging a given system as well as a flexible formulation of very diverse elements. The implementation in Netlogo will enable us in a near future to evaluate the feasibility of applying different assessment methods like CBA, LCA, CSR and IA (see above) to such an example and to criticize objectively these methods. Other examples such as the implementation of a public policy are also envisaged to test the generality of the approach. A key methodological principle will be to use a perturbative approach (Judd, 1996) to measure the impact of the demand for a given good: repeat twice series of simulations with the same initial state, with and without the specific demand and production of a given final resource.

The model should allow us to understand how the four methods integrate the social costs and impacts as well as the distant, complex consequences of what is assessed and how the methods are able to cope with the social issues “upstream” and “downstream” the evaluated entity or process.

Using computer based or human based social simulations provides a way for expanding the scope of social issues considered in the assessment by the various methods addressed. We envisage tackling specific issues such as the induced social transformation for behaviors, beliefs, norms, networks, adoption of innovation or change, mood, perception, reputation, second order impacts of the induced changes on individuals and groups, impact of including the stakeholders in the assessment process itself, long term impact and resilience of the social systems.

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